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CABLE WITH BUILT IN-FRAME GRABBER
FOR A DENTAL VIDEO CAMERA

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1 BACKGROUND OF THE INVENTION

2 The field of the invention is dental video cameras with
3 a frame grabber that is an image capturing apparatus.

4 U. S. Patent No. 6,305,933 teaches the use of a frame
5 grabber that is image acquisition hardware that is Alaris
6 quick video transport. This results in a sampled color of
7 24 bits being stored on the personal computer. It has an S-
8 Video input to match the output from the dental video camera
9 to provide the best possible results by using the best
10 signal output from the dental video camera. The software
11 uses a Twain protocol interface to grab images from the
12 video dental camera using the frame grabber. A standard
13 software interface allows other dental video cameras and
14 frame grabbers to be tested without the need for a change of
15 software.

1 U. S. Patent No. 6,317,152 teaches a digital video
2 recording system that includes a processor and a digital
3 video camera that is directed at a scene of interest to
4 continuously view the scene and generate video images of the
5 scene at a predetermined frame rate. A frame grabber
6 converts the images to digital signal. The processor
7 processes the signals and compares the video image that is
8 represented by a digital signal with a previously
9 established reference of the scene to determine if changes
10 have occurred. The processor has a memory in which contents
11 of each digital signal are stored, together with the time
12 and date information as to when the image was acquired.

13 U. S. Patent No. 6,015,088 teaches a process that
14 allows a frame grabber to be integrated with a personal
15 computer to continuously display a video image of the
16 imaging apparatus. Upon proper input by a user, or
17 automatically after a timed interval, a snapshot of the
18 video image is captured. An auto-discrimination process of

1 the captured video image automatically decodes any bar-coded
2 information present in the captured image and outputs the
3 information. An imaging assembly is provided for receiving
4 an image of an object T and generating an electrical output
5 signal indicative of the data optically encoded thereon, if
6 any. The imaging assembly may include an image sensor 14,
7 such as a 1D or 2D CCD or MOS solid state image sensor
8 together with an imaging optics assembly for receiving and
9 focusing an image of the object T onto a substrate of the
10 image sensor. Particular assemblies of this type are
11 described in U. S. Patent No. 4,755,873 and U. S. Patent No.
12 4,651,202. The imaging device also includes electronics
13 that allows interfacing with a frame grabber that interfaces
14 directly with a computer that may be a Compaq Pentium 120
15 based personal computer. The frame grabber is a Flashpoint
16 Lite that is manufactured by Integral Technologies, Inc.
17 The personal computer includes a microprocessor which is a
18 programmable control device that is able to receive, output

1 and process data in accordance with a stored program that is
2 maintained within either or both of a read/write random
3 access memory and a hard drive.

4 U. S. Patent 6,186,944 teaches a dental/medical
5 instrument for use in diagnostic and related patient
6 inspection/examination that includes a body having an
7 integral speculum with a video image capture device or
8 camera, a power supply and a video display. These
9 components, in addition to user actuatable controls,
10 are disposed integrally with the body. The body is adapted
11 for convenient engagement and manipulation by a user's hand
12 to provide a unitary, hand-held device capable of
13 illuminating and capturing an image of a patient and
14 displaying the image.

15 U. S. Patent No. 6,093,019 teaches a dental imaging
16 system that extracts still images from a digital movie of a
17 patient's mouth. The system allows still images free of
18 shakes or flutter to be taken using an intra-oral camera at

1 the desired angle more easily than using conventional still
2 image capture systems which may require several retakes
3 before realizing a flutter-free image at the correct angle.
4 A general purpose personal computer of the Windows and Intel
5 or of the Apple MacIntosh.TM. variety. More specialized
6 machines such as image processing-type workstations can also
7 be used. The Wintel personal computer can feature an Intel
8 Pentium processor running a Microsoft Windows graphical user
9 interface. The hardware may be centered around a Peripheral
10 Components Interconnect bus. The processor, program memory
11 normally include semiconductor random access memory,
12 display, mass storage device, such as a magnetic and/or
13 optical disk drive, and a motion image capture device, such
14 as a digital video capture card or board. The video capture
15 card can be one that supports Microsoft's Video for Windows
16 suite of imaging and graphics protocols. The video capture
17 card is coupled to the image detecting device being, for
18 instance, an intra-oral camera, via an analog signal

1 interface such as one that supports the industry standard S
2 Video output. The video capture card will have the proper
3 hardware (including logic circuitry and/or a programmed
4 processor) to interface with the intra-oral camera and to
5 implement the function of an image frame grabber as known to
6 those skilled in the art. The intra-oral camera has an
7 optical system and image sensor technology that are suitable
8 for obtaining acceptable quality images of a patient's mouth
9 and teeth for dental diagnosis purposes, as known to those
10 skilled in the art. The needed software for orchestrating
11 image capture, display, and storage can be written using
12 different programming languages and tools, such as the C
13 language and the Microsoft Windows Application Programming
14 Interface.

15 U. S. Patent No. 6,190,309 teaches a video scope that
16 has an entry section and a grip section. The entry section
17 can advance into an object. The grip section is disposed at
18 the back of the entry section and to be held by an operator.

1 The video scope includes a light-reflecting body, an
2 objective-lens, a solid-state image-pickup device, a light
3 source, a window of incidence for image pickup rays and
4 illumination windows that are located in the vicinities of
5 the window of incidence. A power source is disposed in the
6 grip section for driving the light source. A portable
7 accommodation case has an accommodation space for
8 accommodating the video scope. A lid has a thin display
9 attached thereto and can rotate freely and stop at an
10 optional position. The thin display is capable of
11 displaying an image that is picked up by the video scope.

12 U. S. Patent No. 5,908,294 teaches a hand-held dental
13 video camera which includes a window for receiving light. In
14 some aspects of the invention, a lamp is mounted distally
15 beyond the window and aimed to illuminate a subject. A
16 white light emitting diode is used to illuminate the
17 subject.

18 U. S. Patent No. 5,523,782 teaches a video dental

1 camera that includes a light source, a charge coupled device
2 and an adjustable focus lens system.

3 U. S. Patent No. 5,429,502 teaches a dental camera that
4 uses an external light source and route the light from the
5 source to the head using fiber optics. In this arrangement
6 the optical fibers travel through the cable and through the
7 body of the handheld camera unit thereby resulting in a
8 stiffer cable reducing maneuverability and a thicker
9 handheld unit. The fiber optic connections require a
10 complex and expensive connector as compared to fully
11 electrical connectors. Using fiber optics to illuminate the
12 subject requires increased power because some of the light
13 energy is lost in the optical fiber.

14 There are imaging devices that use lamps at the end of
15 the imaging head instead of fiber optics. These lamps have
16 not been used in configurations that minimize the thickness
17 of the instrument. The lamps in the dental camera of U. S.
18 Patent No. 5,523,782 are positioned axially away from the

1 imaging window. The lamp in the dental camera of U. S.
2 Patent No. 4,575,805 is positioned on the proximal side of
3 the imaging window. Both of these configurations result in
4 relatively thick instruments. The lamps that are used in
5 previous imaging devices had significant shortcomings.

6 U. S. Patent No. 5,124,797 teaches a video-imaging
7 camera that has a detachable distal module that is
8 replaceable with one of different characteristics and is
9 able to be sterilized. A non-replaceable charge coupled
10 device and a video transmitter are connected to an inner
11 body that includes a lens tube. The module includes an
12 outer body encasing the inner body. The inner body may have
13 a filter at its tip and a magnifying lens optically
14 connected to an image conduit optical segment. The inner
15 body receives an image conduit. The lens focuses the output
16 of the image conduit and is disposed in the inner body on a
17 charge coupled device microprocessor. The model may be
18 replaced with an angular distal end or lenses of different

1 fields of view. Fiber optic light filaments may be used to
2 illuminate the field of view of the tip of the module,
3 either housed internally or externally of the inner body.

4 U. S. Patent No. 5,296,944 teaches an image scanner
5 that includes a light source. The light source illuminates
6 an original document. An image sensor receives a reflected
7 light from the original document and converts the same into
8 an output signal of image data. A device relatively moves
9 the original document and the image sensor. An iris
10 mechanism is provided on an optical path between the
11 original document and the image sensor. A reference
12 reflection plane is provided such that a light from the
13 light source is reflected and the reflection light becomes
14 incident on the image sensor. A comparing circuit compares
15 a level of an output signal from the image sensor with a
16 reference level when the image sensor receives the light
17 from the reference reflection plane. A device for corrects
18 a dynamic range of the image scanner by controlling the iris

1 mechanism on the basis of the compared output.

2 U. S. Patent No. 4,915,626 teaches a dental video
3 camera which is used to view an image of the interior of the
4 mouth of a patient. The dental video camera displays
5 contemporaneously a video image of the interior of the
6 mouth.

7 U. S. Patent No. 4,589,404 teaches a laser endoscope
8 that includes a video camera and an optical system. The
9 video camera transmits an image through the optical system.

10 U. S. Patent No. 4,600,939 and U. S. Patent No.
11 4,639,772 teach a highly compact video camera which includes
12 an optical system and which is able to be focused, a sensor-
13 converter and a video electronic processing circuit. The
14 sensor-converter receives an optical image passing through
15 the optical system and converts the optical image to an
16 unprocessed video signal. The video electronic processing
17 circuit processes the unprocessed video signal.

18 U. S. Patent No. 5,527,261 teaches a hand-held, fully

1 remote diagnostic instrument having video capability which
2 is configured for any one of a number of clinical or
3 industrial applications. The instrument has a casing that
4 includes a hand-held body portion, a neck portion that
5 extends from the body portion to a head portion that is
6 formed of a back cover, a front cover, and a sealing gasket
7 to form an instrument that may be fully soaked. A circuit
8 board assembly in the body portion contains video processing
9 circuitry and a flexible neck board. The neck board extends
10 forward from the body portion through the neck portion of
11 the casing to a headboard located in the head portion of the
12 casing. A solid-state imager and a miniature lamp are
13 disposed on the headboard. The front cover contains an
14 adjustable focus lens cell for focusing on the imager an
15 image of a target in the field of view of the lens cell.
16 The instrument can be configured for various applications by
17 installing front and back covers that are suited for a
18 specific purpose. The instrument can thus be used as a

1 dental camera. The instrument provides a monitor-ready,
2 standard format, full color video signal to a remotely
3 located monitor.

4 The applicant hereby incorporates the above referenced
5 patents into his application.

6 SUMMARY OF INVENTION

7 The present invention is generally directed to a dental
8 video camera system. The dental video camera system
9 includes a monitor, a cable and a dental video camera. The
10 dental video camera includes a housing, a focusing lens, a
11 light source and a charge coupled device camera system. The
12 focusing lens and the charge coupled device camera system
13 are disposed in the housing. The light source is disposed
14 at the distal end of the elongated cavity of the housing.
15 The cable couples the dental video camera to the monitor.
16 The dental video camera also includes a mechanism that
17 adjusts the charge coupled device camera system between a
18 near field of focus and a far field of focus.

1 In a first separate aspect of the present invention,
2 the cable includes a built-in frame grabber.

3 In a second separate aspect of the present invention,
4 the cable includes a built-in camera power supply.

5 Other aspects and many of the attendant advantages will
6 be more readily appreciated as the same becomes better
7 understood by reference to the following detailed
8 description and considered in connection with the
9 accompanying drawing in which like reference symbols
10 designate like parts throughout the figures.

11 The features of the present invention which are
12 believed to be novel are set forth with particularity in the
13 appended claims.

14 BRIEF DESCRIPTION OF THE DRAWINGS

15 Fig. 1 is a perspective drawing of a dental video
16 camera system that includes a dental video camera, a
17 monitor, a cable-assembly with a built-in frame grabber and
18 a camera power supply according to the present invention.

1 Fig. 2 is a top perspective view of the dental video
2 camera of Fig. 1.

3 Fig. 3 is a bottom perspective view of the dental video
4 camera of Fig. 1.

5 Fig. 4 is a side elevation in cross-section of the
6 dental video camera of Fig. 1 that includes a focused camera
7 assembly with a charge-coupled device and a cable connector
8 assembly.

9 Fig. 5 is an exploded perspective view of the built-in
10 frame grabber of the cable assembly of Fig. 1.

11 Fig. 6 is the schematic drawing of the circuit diagram
12 of the frame grabber of Fig. 1.

13 Fig. 7 is the schematic drawing of the circuit diagram
14 of the power supply of Fig. 1.

15 DESCRIPTION OF THE PREFERRED EMBODIMENTS

16 Referring to Fig. 1 in conjunction with Fig. 2 a dental
17 video camera system 10 includes a monitor 11, a cable
18 assembly 12, a power supply 13, a power supply cable 14 with

1 a power supply connector 15. The dental video camera system
2 10 also includes a dental video camera 20. The cable
3 assembly 12 couples the dental video camera 20 to the
4 monitor 11. The cable assembly 12 may also couple the
5 dental video camera 20 to either a computer or a printer.

6 Referring to Fig. 2 in conjunction with Fig. 3 and Fig.
7 4 the dental video camera 20 includes housing 21. The
8 dental video camera 20 also includes an adjustably focusing
9 lens and a charge-coupled device (CCD) camera system 22, an
10 iris 23, a plurality of light emitting diodes 24, a circuit
11 board 25 with a video-processing circuitry 26 and a camera
12 connector 27. The housing 21 has an elongated cavity with a
13 distal end and a proximal end. The adjustably focusing lens
14 and CCD camera system 22 is disposed within the elongated
15 cavity of the housing 21. The adjustably focusing lens and
16 CCD camera system 22 provides a focusing adjustment between
17 a near field of focus and a far field of focus. The iris 23
18 may be adjustable optically and is mechanically coupled to

1 the adjustably focusing lens and CCD camera system 22. If
2 the iris 23 is adjustable, it may be a stretchable disc of
3 material with a center pinhole that is a slidable portion of
4 the adjustably focusing lens and CCD camera system 22. The
5 iris adjusts between a nearly closed opening and a wide open
6 opening in response to the focusing adjustment between the
7 near field of focus and the far field of focus. There may
8 be a fixed focusing lens system optically which may be
9 coupled to the adjustable CCD camera system 22 and which is
10 disposed in the elongated cavity of the housing 21.

11 Referring to Fig. 5 in conjunction with Fig. 1 the
12 cable assembly 12 includes a camera cable 50 with a
13 complement camera connector 51, an input housing 52, a first
14 connector 53. The first connector 53 is disposed in the
15 input housing 52. The camera connector 51 electrically
16 couples the dental video camera 20 through the camera
17 connector 27 to the camera cable 51. The camera cable 51 is
18 electrically coupled to the first connector 53. The cable

1 assembly 12 also includes a monitor cable 54 with a monitor
2 connector 55, an output housing 56, a complement-monitor
3 connector 57, a complement-power supply connector 58 and a
4 complement-first connector 59. The complement-monitor
5 connector 56 and the complement-power supply connector 57
6 are disposed in the output housing 55. The complement
7 camera connector 51 electrically couples the dental video
8 camera 20 through the camera connector 27 to the camera
9 cable 51. The monitor cable 54 is electrically coupled to
10 the monitor 11.

11 Referring to Fig. 6 in conjunction with Fig. 5 and Fig.
12 7 a circuit module 60 has a second connector 61, a
13 complement-second connector 62. The circuit module 60 also
14 includes a frame grabber interface circuit 63 and a camera
15 power supply circuit 64. The frame grabber interface
16 circuit 63 electrically couples the dental camera 20 to the
17 monitor 11. The camera power supply circuit 64 electrically
18 couples the dental camera 20 to the power supply 13.

1 From the foregoing it can be seen that a cable assembly
2 with a circuit module for a frame grabber for electrically
3 coupling a monitor and a power supply to a dental video
4 camera has been described. It should be noted that the
5 sketches are not drawn to scale and that distances of and
6 between the figures are not to be considered significant.

7 Accordingly it is intended that the foregoing
8 disclosure and showing made in the drawing shall be
9 considered only as an illustration of the principle of the
10 present invention.